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Public transport - Communication between contactless readers and fare media - Part 1: Implementation requirements for ISO/IEC 14443

Öffentlicher Verkehr - Kommunikation zwischen berührungslosen Lesegeräten und Fahrschein Medien - Teil 1: Implementierungsanforderungen zur ISO/IEC 14443

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Public transport - Communication between contactless readers and fare media - Part 1: Implementation requirements for ISO/IEC 14443

Transport Public - Système billettique interopérable -
Communication entre terminaux et objets sans contact -
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Öffentlicher Verkehr - Kommunikation zwischen
berührungslosen Ladegeräten und Fahrscheinmedien - Teil
1: Implementierungsanforderungen zur ISO/IEC 14443

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CEN/TS 16794-1:2015 (E)

Contents

Foreword

This document (CEN/TS 16794-1:2015) has been prepared by Technical Committee CEN/TC 278 "Intelligent transport systems", the secretariat of which is held by NEN.

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CEN/TS 16794-1:2015 (E)

Introduction

These implementation requirements represent the first step in a process designed to ensure contactless communication interoperability between fare management system terminals and any fare media liable to be accepted by them. The end-purpose of this document is therefore to prepare the ground for European deployment of a certification process on contactless communication protocols guaranteeing technical interoperability between fare management system terminals and fare media.

These implementation requirements set out the requirements related to the use of ISO/IEC 14443 to ensure interoperability between fare management system terminals and multiple-form-factor contactless fare media (smartcards, e-tickets, mobile phones, USB keys, tablets, etc.).

These implementation requirements are not designed to repeat or duplicate the referenced specifications (essentially standards ISO/IEC 14443 and ISO/IEC 10373-6) but to finalize some specific points and to define their testing and use conditions, and thus ultimately to improve overall interoperability.

These implementation requirements have been built to facilitate co-compliance of a given fare management system terminal or fare media on both these implementation requirements and one or more other standard specifications like EMVCo Book D or NFC Forum Analog and Digital Technical specifications.

These implementation requirements include the following key clauses:

— Clause 6 presents general considerations applicable to fare management system terminals and fare media.

iTeh STANDARD PREVIEW

— Clause 7 sets out the requirements specific to contactless fare management system terminals.

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— Clause 8 sets out the requirements specific to contactless fare media.

— Clause 9 sets out the test conditions for the certification of contactless fare management system terminals and contactless fare media under these implementation requirements. It also lists the implementation characteristics to be provided by fare management system terminal manufacturers and contactless fare media manufacturers as a prerequisite to the certification process.

— Various possible polling sequences are given in Annex A for information purposes.

1 Scope

This Technical Specification sets out the technical requirements to be met by contactless fare management system terminals and contactless fare media hosting a transport ticketing application in order to be able to interface together using the ISO/IEC 14443 standard contactless communications protocol.

This Technical Specification applies to:

— any **contactless fare management system terminal** acting as a PCD **contactless reader** based on ISO/IEC 14443 standard series;

— any **contactless fare media** acting as a PICC **contactless object** based on ISO/IEC 14443 standard series.

The purpose of these implementation requirements is to ensure contactless communications interoperability between contactless fare management system terminals and any contactless fare media liable to be accepted by them, once both terminal and fare media have been certified as meeting the requirements of these implementation requirements. An interface–oriented test approach will be used to evaluate the interoperability of relevant components and is defined in CEN/TS 16794-2, *Public transport — Communication between contactless readers and fare media — Part 2: Test plan for ISO/IEC 14443*.

Application-to-application exchanges executed once contactless communication has been established at RF level fall outside the scope of these implementation requirements. In line with the rules on independency between OSI protocol layers, these implementation requirements work on the assumption that application-to-application exchanges are not contingent on the type of contactless communication established or by the parameters used for the low-level protocol layers that serve as the platform for these application-to-application exchanges.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

CEN/TS 16794-2, *Public transport — Communication between contactless readers and fare media — Part 2: Test plan for ISO/IEC 14443*

ISO/IEC 10373-6:2011, *Identification cards — Test methods — Part 6: Proximity cards*

ISO/IEC 10373-6:2011/Amd.1:2012, *Identification cards — Test methods — Part 6: Proximity cards / Amendment 1: Additional PICC classes*

ISO/IEC 10373-6:2011/Amd.2:2012, *Identification cards — Test methods — Part 6: Proximity cards / Amendment 2: Test methods for electromagnetic disturbance*

ISO/IEC 10373-6:2011/Amd.3:2012, *Identification cards — Test methods — Part 6: Proximity cards / Amendment 3: Exchange of additional parameters, block numbering, unmatched AFI and TR2*

ISO/IEC 10373-6:2011/Amd.4:2012, *Identification cards — Test methods — Part 6: Proximity cards / Amendment 4: Bit rates of fc/8, fc/4 and fc/2 and frame size from 512 to 4096 bytes*

ISO/IEC 10373-6:2011/Cor.1:2013, *Identification cards — Test methods — Part 6: Proximity cards / Technical Corrigendum 1: R2 value range, start of PICC transmission and program for EMD level measurement*

ISO/IEC 14443-1:2008, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 1: Physical characteristics*

CEN/TS 16794-1:2015 (E)

ISO/IEC 14443-1:2008/Amd.1:2012, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 1: Physical characteristics / Amendment 1: Additional PICC classes*

ISO/IEC 14443-2:2010, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 2: Radio frequency power and signal interface*

ISO/IEC 14443-2:2010/Amd.1:2011, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 2: Radio frequency power and signal interface / Amendment 1: Limits of electromagnetic disturbance levels parasitically generated by the PICC*

ISO/IEC 14443-2:2010/Amd.2:2012, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 2: Radio frequency power and signal interface / Amendment 2: Additional PICC classes*

ISO/IEC 14443-2/Amd.3:2012, *Identification cards — Proximity cards — Part 2: Radio frequency power and signal interface / Amendment 3: Bits rates of fc/8, fc/4 and fc/2*

ISO/IEC 14443-3:2011, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 3: Initialization and anticollision*

ISO/IEC 14443-3:2011/Amd.1:2011, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 3: Initialization and anticollision / Amendment 1: Electromagnetic disturbance handling and single-size unique identifier*

ISO/IEC 14443-3:2011/Amd.2:2012, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 3: Initialization and anticollision / Amendment 2: Bit rates of fc/8, fc/4 and fc/2, frame size from 512 bytes to 4 096 bytes and minimum TR0*

ISO/IEC 14443-4:2008, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 4: Transmission protocol*

ISO/IEC 14443-4:2008/Amd.1:2012, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 4: Transmission protocol / Amendment 1: Exchange of additional parameters*

ISO/IEC 14443-4:2008/Amd.2:2012, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 4: Transmission protocol / Amendment 2: Bit rates of fc/8, fc/4 and fc/2, protocol activation of PICC Type A and frame size from 512 bytes to 4 096 bytes*

ISO/IEC 15693-2:2006, *Identification cards — Contactless integrated circuit cards — Vicinity cards — Part 2: Air interface and initialization*

ISO/IEC 18092:2013, *Information technology — Telecommunications and information exchange between systems — Near Field Communication — Interface and Protocol (NFCIP-1)*

EMV Contactless Communication Protocol Specification (2014), *EMV Contactless Specifications for Payment Systems — Book D — EMV Contactless Communication Protocol Specification — Version 2.4 February 2014*

NFC Forum™ - NFC Analog Specification (2012), *Technical Specification - NFC Forum™- ANALOG 1.0 - NFCForum-TS-Analog-1.0 - 2012-07-11*

NFC Forum™ - NFC Digital Specification (2014), *Technical Specification - NFC Forum™- DIGITAL 1.1 - NFCForum-TS-Digital-1.1 - 2014-05-20*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
"battery low" mode
in the case of battery-powered NFC systems, "battery low" mode is as defined in Section 3.5 of GSMA's white paper: GSM Association: Requirements For SWP NFC Handsets V4.0 – March 2011

3.2
common reader
contactless reader interface designed for terminals with reduced performance requirements

3.3
IFM Reader
contactless reader used in Interoperable Fare Management system terminals

3.4
PCD assembly
test PCD assembly (test reader) as defined in test method ISO/IEC 10373-6:2011

3.5
non ISO/IEC 14443-3 frame coding
frame using either:

— ISO/IEC 14443-2 type A modulation, with coding different from REQA or WUPA; or

— ISO/IEC 14443-2 type B modulation, with coding different from REQB or WUPB; or

— ISO/IEC 18092 modulation; or

— ISO/IEC 15693-2 modulation

3.6
Reference PICC
Reference PICC (test card) as defined in test method ISO/IEC 10373-6:2011

4 Symbols and abbreviations

The following abbreviated terms are used in this document:

AFI   Application Family Identifier, Type B

ATQB   Answer To Request, Type B

EMD   Electro Magnetic Disturbance

FWI   Frame Waiting time Integer

FSCI   Frame Size for proximity Card Integer

NFC   Near Field Communication

PCD   Proximity Coupling Device

PICC   Proximity IC Card

PTO   Public Transport Operator

PUPI   Pseudo-Unique PICC Identifier, Type B

REQA   Request Command, Type A

CEN/TS 16794-1:2015 (E)

REQB   Request Command, Type B

RF   Radio Frequency

SFGI   Start-up Frame Guard Time Integer

SFGT   Start-up Frame Guard Time

t_{detect} Maximum Reference PICC time-to-detection

UID   Unique Identifier, Type A

WUPA   Wake-UP Command, Type A

WUPB   Wake-UP Command, Type B

5   Conformance

Conformance to the present implementation requirements carries a number of requisites:

— For a contactless reader, to meet all the [Rdr*nn*]   requirements listed herein that are applicable according to the applicant's stated implementation characteristics (ICS), under the test conditions stipulated in Clause 2 and following the PCD Reader test plan set out in CEN/TS 16794-2.

— For a contactless object, to meet all the [Obj*nn*]   requirements listed herein that are applicable according to the applicant's stated implementation characteristics (ICS), under the test conditions stipulated in Clause 2 and following the PICC Media test plan set out in CEN/TS 16794-2.

The validation process to be carried out by contactless object and contactless reader manufacturers or integrators is out of scope of the present specification.

6   General considerations for fare media and contactless readers

6.1   Combining the present requirements with others industry standards

The implementation requirements are designed to facilitate the software and hardware migration roadmap for existing fare management system terminals and to minimize the allied roadmap costs by integrating existing contactless ticketing test specifications (regional or local test specifications used in population clusters aiming for transport interoperability). Moving forward along these lines, the specifications do not impose a unique predefined polling sequence for fare management system terminals, but define minimal requirements for polling sequence, thus leaving each transport network free to integrate into this sequence those contactless fare media that are off-scope, i.e. non-compliant to the ISO/IEC 14443 requirements on Type A or B as outlined herein.

These implementation requirements, for those transport networks that opt in, also give the possibility to get an EMVCo L1 certification on fare management system terminals designed to accept contactless payment as the transport network fare payment and access system, regardless of the type of media hosting the allied applications: contactless smartcards, NFC-enabled mobile phones, NFC-enabled secure memory cards, etc.

In order to facilitate joint compliance to these requirements and to EMVCO requirements, notes have been added where EMVCo imposes restricted implementation and these current implementation requirements are more open.

Similarly, when NFC devices are used as fare management system terminals or as fare media, additional certification such as NFC Forum certification may be requested for these devices. It should be possible for an NFC-enabled device to comply both with these implementation requirements and with NFC Forum's Analog and Digital Technical specifications. Some discussions will take place between the CEN TC 278 Working Group 3 SG 5 and NFC Forum's SIG Transport to look after requirements harmonization.

The requirements set out in these implementation requirements are applicable to contactless fare media, whether they are dedicated solely for use in a transport fare solution or whether they are designed to host a number of contactless applications from other sectors (telecom, banking, mass retail, etc.) in addition to a transport application. By this, transport-sector contracting authorities can require conformance to these requirements when making procurement orders for transport-network fare management system terminals and contactless fare media. It is equally desirable that the manufacturers of multi-capability contactless fare media (NFC-enabled smartphones, contactless USB keys, NFC-enabled secure memory cards, multi-application-carrying contactless cards) ensure their products conform to these implementation requirements to make them eligible for hosting fare management system applications.

NFC mobile devices designed and tested according to NFC Forum specifications will be covered in Edition 2 of this Technical Specification. The work on Edition 2 is intended to complement Edition 1 for NFC Forum devices and not to rework Edition 1. Edition 2 will ensure backward compatibility with Edition 1 requirements.

6.2 Progressive and flexible approach to the targeted interoperability

These implementation requirements should make it possible to accept a broad spectrum of contactless fare media, without distinction between form factors not smaller than Class 3 such as: contactless smartcards in ID-1 format (as defined in ISO/IEC 7810), contactless tickets, contactless USB keys and NFC-enabled mobile phones, or any other contactless fare media that is a PICC and is in conformance with the requirements stipulated in these implementation requirements. This requires that PT infrastructures follow the amendments on additional PICC classes that are provided with the latest version of ISO/IEC 14443 and ISO/IEC 10373-6 standards.

In the past, significant investments in PT infrastructures have been made by PTOs across Europe. These comply mainly with previous versions of ISO/IEC 14443 and support interoperability with Class 1 PICC (e.g. ID1-cards) only. The targeted interoperability with next generation fare media like NFC mobile devices and smart objects within PICC classes 2 or 3 would probably require an update of this reader infrastructure and generate significant cost. The following step-by-step approach will facilitate an economically viable transition that can be accepted and justified by the PTO:

a) In the first step, interoperability may be supported for classical fare media (Class 1 PICC) only. The reader infrastructure has to support ISO/IEC 14443 and ISO/IEC 10373-6 but not the amendments related to additional PICC classes.

b) As soon as the PTO wants to introduce mobile services and next generation fare media like NFC mobile devices and smart objects within PICC classes 2 or 3, the infrastructure has to be upgraded to comply with the latest version of ISO/IEC 14443 and ISO/IEC 10373-6 standards including the amendments on additional PICC classes. By this, a mandatory precondition for the targeted interoperability for all fare media in the scope will be reached. At this point, the investment into the update of the reader infrastructure has to be made but it can be justified by new services and enhanced customer value.

7 Requirements on contactless readers

7.1 General

This clause sets out the requirements applicable to contactless fare management system terminals acting as PCD **contactless readers** based on ISO/IEC 14443 standard.

— Requirements described in 7.3, 7.4 and 7.5 are normative and mandatory to achieve interoperability.

— Requirement described in 7.6 is informative only, hence not necessary to achieve interoperability.

Requirements on contactless readers are identified by a numbering format that reads [Rdrnn] where nn is the number of the requirement.

CEN/TS 16794-1:2015 (E)

7.2 Categories for contactless reader

This Technical Specification reflects that contactless readers' requirements depend on particular use cases. Therefore two categories of readers are introduced:

— The first category, the "IFM Reader", covers use cases where performance (i.e. reading distance, transaction time) is key.

— The second reader category, the "Common Reader", is defined for scenarios that impose requirements on the contactless interface such as minimization of cost or maximisation of battery life of the reader. These requirements have been derived from use cases from the following parts of the PTO's system implementation:

  — sales infrastructure,

  — customer's home infrastructure,

  — mobile inspection terminals.

Some requirements given in this specification will be adapted for Common Readers.

There is no compromise against the cost of interoperability as all implementation requirements and tests that are necessary to achieve interoperability between contactless readers and fare media are mandatory for both reader categories.

As indicated in 6.1, Edition 2 will ensure backward compatibility with Edition 1 requirements. This will protect legacy investment in contactless readers and infrastructure equipment.

7.3 Normative requirements for contactless readers

[Rdr1]   Contactless readers shall meet the mandatory normative requirements for PCD defined in the ISO/IEC 14443 standard and associated ISO/IEC 10373-6 test methods standards listed in Clause 2 with the following temporary waivers:

— The limits and test methods for electromagnetic disturbance parasitically generated by the PICC has recently been standardised (ISO/IEC 14443-2:2010/Amd.1:2011, ISO/IEC 14443-3:2011/Amd.1:2011 and ISO/IEC 10373-6:2011/Amd.2:2012) and contactless readers in the field may not be compliant with these standards. The electromagnetic disturbance requirements defined in these standards are therefore informative for existing readers. Existing readers should implement an EMD recovery algorithm to meet, as far as possible, the low EMD time $t_{E,PCD}$ specified in ISO/IEC 14443-3:2011/Amd.1:2011. These electromagnetic disturbance requirements are mandatory for contactless readers produced after the publication of this Technical Specification.

— Additional PICC classes (including e.g. different load modulation amplitude limits for PCD) have recently been standardised (ISO/IEC 14443-2:2010/Amd.2:2012, ISO/IEC 14443-1:2008/Amd.1:2012 and ISO/IEC 10373-6:2011/Amd.1:2012) and most contactless readers in the field may not be compliant with these standards. The requirements defined in these standards are therefore:

  — mandatory for all system infrastructures that use above mentioned additional PICC classes;

  — informative for a transitional period for system infrastructures that use only "Class 1" PICC fare media: this transition period ends as soon as the PTO wishes to support "Class 2" or "Class 3" PICC fare media.

NOTE 1   If contactless objects are introduced into a PT infrastructure using existing readers without EMD compliance, interoperability cannot be guaranteed.